INTELLIGENT VEHICLE ACCESS CONTROL SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to monitoring and/or controlling vehicular access to sites, and in particular providing vehicular undercarriage scanning and/or driver recognition prior to a vehicle entering such sites.

BACKGROUND OF THE INVENTION

[0002] It is necessary to control access of personnel and vehicles to all sites, both civilian and military.

[0003] In recent decades, motor vehicles have been used in the type of terrorist activities that have come to be known as car bombings. Motor vehicles have carried explosives and detonated in a particular location to cause damage to personnel and property.

[0004] It is also the case that a motor vehicle that can legitimately be brought onto a site can be stolen or hijacked by a terrorist group, loaded with explosives and brought onto a site by a terrorist or brought in unawares by driver/passengers.

SUMMARY OF THE INVENTION

[0005] According to one aspect of the invention, there is provided apparatus for the automatic inspection of vehicles being driven into a first area. The apparatus comprises: imaging means, database means and means for comparing. The imaging means is for capturing an image of the undercarriage of a vehicle as it is being driven into the first area. The database means is for storing images of the undercarriages of vehicles which are permitted into the first area. The means for comparing is for comparing the captured image of the undercarriage of the vehicle being driven into the first area with one or more of the stored images of the undercarriages of vehicles on the database means.

[0006] In this aspect, the present invention allows for the scanning of the undercarriage of a vehicle for explosives or other illicit material, verification of both the identity of the driver and the identity of the vehicle, to establish that the particular vehicle is permitted into a sensitive site and that it is currently being driven by a driver who is permitted to drive it into that site.

[0007] According to another aspect of the invention, there is provided apparatus for the automatic inspection of vehicles being driven into a first area. The apparatus comprises: database means, means for capturing, number plate recognition means and means for interrogating. The database means contains: driver identification data identifying drivers who are permitted to drive vehicles into the first area; number plate data identifying vehicles which are permitted into the first area; and data identifying which driver is permitted to bring which vehicle into the first area. The means for capturing is for capturing identification data about a driver who is driving the vehicle into the first area. The number plate recognition means is for capturing number plate data about the vehicle being driven into the first area. The means for interrogating is for interrogating the database means on the basis of the captured identification data about the driver who is driving the vehicle into the first area and on the basis of the captured number plate data to determine whether or not that driver is permitted to drive that vehicle into the first area.

[0008] Either of the above aspects may allow for the scanning of the undercarriage of a vehicle for explosives or other illicit material, verification of both the identity of the driver and the identity of the vehicle, to establish that the particular vehicle is permitted into a sensitive site and that it is currently being driven by a driver who is permitted to drive it into that site.

[0009] According to a further aspect of the invention, there is provided a method for the automatic inspection of vehicles being driven into a first area. The method comprises the steps of: capturing an image and comparing the captured image. The captured image is an image of the undercarriage of a vehicle as it is being driven into the first area. The captured image of the undercarriage of the vehicle being driven

into the first area is compared with one or more stored images of the undercarriages of vehicles which are permitted into the first area.

[0010] According to again another aspect of the invention, there is provided a method for the automatic inspection of vehicles being driven into a first area. The method comprises: capturing data, reading a number and determining whether a driver is permitted to drive a vehicle into the first area. The captured data is identification data about a driver who is driving the vehicle into the first area. The number is the number on the vehicle number plate of the vehicle being driven into the first area. Determining whether the driver is permitted to drive that vehicle into the first area is based on captured identification data about the driver who is driving the vehicle into the first area, on captured number plate data, and on driver identification data identifying drivers who are permitted to drive vehicles into the first area.

[0011] According to a yet further aspect of the invention, there is provided a method of controlling vehicular access to a secure site having at least one entrance with a plurality of inspection zones, each inspection zone being contiguous with at least one other inspection zone and at least one inspection zone being contiguous with the secure site. The method includes the steps of: permitting a driver to bring a vehicle into a first one of the inspection zones, conducting at least one inspection process on the vehicle in the first inspection zone and possibly permitting the driver to bring the vehicle into a second one of the inspection zones and conducting at least one inspection process on the vehicle in the second inspection zone. The vehicle which the driver is permitted to bring a vehicle into the first inspection zone is a vehicle attempting access to the first area. The allowable outcomes of the at least one inspection process in the first inspection zone comprise: (i) the vehicle failing the or at least one inspection process and: (a) the vehicle not being permitted to move out of the first inspection zone; or (b) the vehicle being allowed to leave without proceeding into the first area; and (ii) the vehicle passing the or all the inspection processes and being permitted to move out of the first inspection zone into the second inspection zone. If the vehicle has entered the second inspection zone the at least one inspection process on the vehicle in the second inspection zone is conducted. The allowable outcomes of the at least one inspection process in the second inspection zone comprise: (iii) the vehicle failing the or at least

one inspection process and: (c) the vehicle not being permitted to move out of the second inspection zone; or (d) the vehicle being allowed to leave without proceeding into the first area; and (iv) the vehicle passing the or all the inspection processes and being permitted to move out of the second inspection zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention is further described by way of non-limitative example with reference to the accompanying drawings, in which:

[0013] Figure 1 shows an overview of an apparatus according to one embodiment of the invention;

[0014] Figure 2 is a flowchart illustrating the operation of the apparatus of Figure 1;

[0015] Figure 3 shows the logical architecture of the embodiment of Figure 1;

[0016] Figures 4 and 5 are block diagrams of sub-systems of Figure 3; and

[0017] Figure 6 is an example of the user interface of the embodiment of Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT

The Apparatus of the Invention

[0018] A preferred embodiment of the present invention is illustrated generally at item 1 in Figure 1.

[0019] The arrangement of apparatus according to the embodiment of Figure 1 is in three zones, an identification and psychological profiling zone 2, an automatic inspection zone 3 and a manual inspection zone 4.

[0020] The apparatus of the present invention includes a control center 13. Control and/or signal paths connect components of the system to the control center 13. Those components include biometric and heart rate detection station 8 with an attached

console 7, a traffic light 9, an explosives detection portal 11, undercarriage scanning apparatus 12, one or more fixed cameras 17, an alarm 18 and a physical barrier 19. The apparatus of the present invention can be placed in multiple locations with each installation networked so as to be controlled by a centralized management system. The benefits of a centralized control include more efficient administration, timely maintenance and a reduction in security personnel required to support the multiple installations. Further for facilities having multiple entry and exit points further data can be recorded as to the time of visit and time of exit including duration of the visit. Placing centralized control yields a holistic approach to security with incidents at the installations being managed and controlled along with other security measures and so avoiding the potential for errors or redundancy.

[0021] According to alternative preferred embodiments of the invention which are not shown in the drawings, spike or other suitable barriers are also located at either or both of the transition regions between:

[0022] the identification and psychological zone and the automatic inspection zone; and

[0023] the automatic inspection zone and the manual inspection zone.

[0024] The logical architecture 21 of the system of Figure 1 is illustrated in Figure 3. The central server 22 is running number plate recognition (licence plate recognition - LPR) software 26, undercarriage image processing software 27 and database software 28. The central server 22 presents a user interface 23 to a user. A number plate recognition system 31, driver image system 32 and undercarriage scanning system 33 also have inputs to the central server 22.

[0025] Figure 4 is a representation of the architecture of the number plate recognition system, the software 26 of which runs on the central server 22. The LPR software 26 is used to recognise the number on the vehicle number plate (which, according to the country, may be the registration or licence plate, etc.). This system includes a central computer 37 (which may or may not be the same computer as the central server 22 of Figure 3). The central computer 37 interfaces by way of suitable hardware such as frame grabber 38, communications port 39 and digital I/O card 41

with cameras and sensors 42 and 43. It will be appreciated that, although these cameras and sensors are numbered as items 42 and 43 in Figure 4, their physical implementations include the LPR camera 17 of Figure 1.

[0026] Figure 5 is a representation of the architecture of the undercarriage scanning and driver verification systems. The central computer 37 interfaces by way of a frame grabber 51, video switch 52 and multiplexer 53 with driver verification cameras 54 and undercarriage scanning camera 56. It will be appreciated that, although the driver verification cameras and undercarriage scan camera are numbered as items 54 and 56 in Figure 5, their physical implementations include cameras 14 and 17 of Figure 1 and the undercarriage scanning equipment illustrated as item 12 in Figure 1.

[0027] Figure 6 is a representation of an exemplary computer display on a screen as monitored by security personnel. The screen includes a current undercarriage image 70, the vehicle number plate number and a current image of the driver 62, as well as a past, reference undercarriage image 80 and a past, reference driver image 65. Identification of the vehicle, as it is driven into the inspection system, is initiated through cameras providing the vehicle number plate number which appears in the vehicle data image 60, which also includes the NRIC number of the driver and previous entry and exit times and dates. The current driver image 62 is compared with the stored driver image 65 for inspection by the operator. At the same time the actual undercarriage image 70 "stitched" together to show a composite view on screen is then compared to the stored images 80 of the vehicle undercarriage. Where abnormalities 75 are identified, these may be further enhanced for closer detailed inspection by the operator.

Operation of the Apparatus of the Invention

[0028] The following description of the operation of the apparatus of the invention should be read in conjunction with the top-level flow-chart of Figure 2, which gives an overall view of that operation.

[0029] As a vehicle such as that illustrated at 6 in Figure 1 is driven into the inspection system 1, the driver of the vehicle is presented with a red light by traffic light 9 (action 201 of Figure 2).

[0030] When the vehicle 6 enters the identification and psychological profiling zone 2, it is detected by the camera 17, or other detection means. This detection of the vehicle triggers the number plate recognition system. The number plate recognition functions are then assigned to the camera 17.

[0031] The detection of the vehicle 6 triggers the number plate recognition system and at the same time the driver is prompted to wind down the window, look into the facial identification camera adjacent to the vehicle, and place his or her hand on a sensor in the biometric recognition and heart rate detection console 7. The placement of the driver's hand on this sensor also acts as a trigger to activate the facial identification or eye scanning system.

[0032] In a preferred embodiment, the driver may also be prompted to speak so as measure a voice characteristic. According to further preferred embodiments of the invention, the heart rate data that is captured is compared with base-line pulse rate data about the driver to infer whether or not the driver is exhibiting any nervousness. Similarly the voice characteristic is compared to existing voice data about the driver to determine the identity of the driver, or to infer whether or not the driver is nervous.

[0033] The following decisions are then made.

[0034] Based on the output of the number plate recognition system, a decision is made as to whether or not the vehicle is authorised to enter the secured zone (decision 203 of Figure 2). If the vehicle is not authorised to enter the secured zone, an alarm is raised (204 of Figure 2) or other alerting mechanism.

[0035] Based on the output of the biometric recognition system, a decision is made whether or not the driver is a person who is authorised to enter the secured

zone (decision 207 of Figure 2). If the driver is not authorised to enter the secure zone, an alarm is raised (208 of Figure 2) or other alerting mechanism.

[0036] Based on the output of a heartbeat detector, a decision is made whether or not the driver is exhibiting nervousness at entering the secured zone (decision 212 of Figure 2). If the driver is exhibiting such nervousness, an alarm is raised (213 of Figure 2) or other alerting mechanism.

[0037] If none of these alarms is raised, the driver is presented with a green light (process 209 of Figure 2) and drives the vehicle 6 through the explosives detection portal 11, and over the undercarriage scanning equipment.

[0038] If any illicit material is detected on passage of the vehicle 6 through the explosives detection portal 11, an alarm is raised (213 of Figure 2) or other alerting mechanism.

[0039] The undercarriage scanning equipment is located within a housing, either above ground or below ground level, over which the vehicle will travel. The undercarriage image is created from a composite of images captured by the area scan camera whilst the vehicle is traversing the scanning equipment with the overlapping images "stitched" together to form the complete undercarriage image. The image that is captured of the vehicle undercarriage is compared with previous undercarriage images from a database (215 of Figure 2) and if there is a discrepancy or detected foreign objects between the images an alarm is raised (217 of Figure 2) or other alerting mechanism. These foreign objects may then be highlighted and traced in high resolution on the screen enabling the operator to zoom in for a more detailed inspection.

[0040] In each case the alarm or other alerting mechanism extends to audible and visual alarm means, while also activates engagable physical barriers such as retractable bollards, raised kerbs or spikes each capable of preventing the vehicle from proceeding or retreating. Further the installation may include physical protection means so that in the case of an explosion, the extent of the damage is limited, protecting

life and property. The protection means may further minimise damage to the security apparatus from the explosion.

[0041] The apparatus of the invention is further applicable to both fixed installations and portable installations so as to establish an installation at a temporary site for a given event.

[0042] If neither of these alarms is raised, an image of the vehicle interior is saved (218 in Figure 2) the barrier 19 is opened and the vehicle is free to proceed into the secured facility.

[0043] Various amendments and alternatives falling within the scope of the invention are readily apparent to the skilled artisan.

[0044] The entire disclosure of Australian provisional application No. 2003-900048 filed January 7, 2003 is incorporated by reference.